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WATER RESOURCES SECTION

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BATHYMETRIC SURVEY AND PHYSICAL AND CHEMICAL-RELATED PROPERTIES OF BLACK BAYOU RESERVOIR

INTRODUCTION

Black Bayou Reservoir, formed from an earthen dam built in 1975 on Black Bayou in northwestern Louisiana, is used for water-based activities such as water skiing, fishing, boating, and swimming. An understanding of current hydrologic conditions of this reservoir and other reservoirs and lakes in Louisiana is essential to the management and protection of these valuable natural resources. Water quality and quantity are important concerns to those who use these bodies of water for municipal, recreational, agricultural, or industrial purposes. Current and accurate information regarding the physical and chemical-related properties and conditions of freshwater reservoirs and lakes in Louisiana is fundamental to planners and managers for evaluating these resources. In October 1996, the U.S. Geological Survey, in cooperation with the Louisiana Department of Transportation and Development, began a study to conduct a bathymetric survey and determine the physical and chemical-related properties of Black Bayou Reservoir.

The purpose of this report is to present the results of the bathymetric survey and the results of vertical profiles of physical and chemical-related properties, including depth, water temperature, dissolved oxygen (DO), specific conductance, and pH, which were measured at three sites in the reservoir. Hydrographic surveying software was used for combining differential global positioning system (DGPS) information with digital survey fathometer data to accurately map the bathymetry of the reservoir. The bathymetric map was produced using geographic information systems (GIS), and lines of equal depth of water were reviewed and edited for accuracy and consistency. On-site physical and chemical-related properties were measured at the three selected locations using a water-quality monitor. This report is one in a series of planned map reports describing current bathymetry and physical and chemical-related properties of reservoirs and lakes in Louisiana.

Description of Study Area

Black Bayou Reservoir (fig. 1) is located in Bossier Parish, about 8 miles north of Shreveport, Louisiana, and 3 miles southeast of Benton, Louisiana. A 1997 census estimated a population of 93,752 for Bossier Parish, 200,827 for Shreveport, and 2,038 for Benton (University of Louisiana at Monroe, Uniform Resource Locator accessed December 1, 1998). This area has a subtropical transitional climate with a mean annual rainfall of 46.1 inches and a mean annual temperature of 54.2oF (degrees Fahrenheit) (Jay Grymes, Louisiana Office of State Climatology, written commun., 1998).

Black Bayou Reservoir has a drainage area of 26 square miles and receives inflow from Black Bayou. The earthen dam is 4,800 feet in length. The reservoir level is controlled by a spillway 150 feet in length, and has a crest elevation of 185 feet above sea level. The maximum discharge for the spillway structure is 13,680 cubic feet per second (Ray Elifami, Louisiana Department of Transportation and Development, oral and written communs., 1998). The bathymetry of Black Bayou Reservoir varies, and contains evidence of the once meandering channels of Black Bayou.

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BATHYMETRY

Bathymetric data for Black Bayou Reservoir were collected during October 7-8, 1997. Accurate position and depth data were obtained to comprehensively describe the bathymetry of the reservoir; 36,682 data points of latitude, longitude, and depth were recorded. The bathymetry of the reservoir is shown in figure 1; water depths are referenced to the water-surface elevation of 183.6 feet above sea level.

Equipment used for the bathymetric survey included a Starlink DNAV-212 DGPS, an Odom digital survey fathometer, and HYPACK software. The DGPS measured spatial position in latitude and longitude with routine accuracy of 5 feet; horizontal control points were established at the beginning and rechecked at the end of each survey day to maintain that accuracy. The survey fathometer measured the depth with routine accuracy of 0.1 foot; the fathometer was calibrated at the start and verified at the end of each survey day to maintain that accuracy. The HYPACK software was used for survey planning, survey execution, and storage and editing of data. Data were exported to ARC/INFO for drawing lines of equal depth of water and subsequent reviewing and editing of results. Data were exported to ARC/INFO for drawing lines of equal depth of water and subsequent reviewing and editing of results.

Surface area and volume spatial analyses also were performed within ARC/INFO. The water-surface area of Black Bayou Reservoir was 590 acres, and the water volume was 5,850 acre-feet. The depth-surface area and depth-volume relations are shown in figure 2. The average depth of the reservoir was 9.9 feet, with a depth of 9.5 feet or greater over more than 50 percent of the reservoir-surface area. Depths are highly varied, and generally shallow moving in a northwestern direction toward Black Bayou.

PHYSICAL AND CHEMICAL-RELATED PROPERTIES

Data on physical and chemical-related properties were collected on September 24, 1997, at selected sites in Black Bayou Reservoir. At these sites (1, 2, and 3 in fig. 1), multiple points along a vertical profile were sampled to establish the occurrence and depth of stratification. The HYDROLAB, a water-quality monitor, was calibrated at the beginning of each day prior to physical and chemical-related property data collection.

Data were collected along a vertical profile from above the reservoir bed to 1.6 feet below the water surface, with additional sampling points within the stratification zone. The deepest measurements at the three sampling sites were as follows: 11.8 feet at site 1, 13.8 feet at site 2, and 14.8 feet at site 3. Water temperature remained constant at approximately 80oF from the surface to approximately 10 feet in depth, then decreased more rapidly with depth, with the deepest measurement of 75oF at 14.8 feet (fig. 3).

The DO concentration profiles showed stratification occurring at a depth between 10 and 14 feet. Shallow-water DO concentrations ranged from 3.5 to 4.3 mg/L (milligrams per liter), and bottom-water DO concentrations ranged from 0.24 to 0.98 mg/L. DO concentrations vary considerably with depth, location, and season (Demas, 1985). The criterion for DO is 5 mg/L for freshwater aquatic life (Louisiana Department of Environmental Quality, 1998, p. 128; U.S. Environmental Protection Agency, 1976; 1986). Water visibility, measured with a Secchi disk, was 2.4 feet.

The specific conductance remained constant at 61 mS/cm (microsiemens per centimeter at 25 degrees Celsius) from the surface to approximately 10 feet. Below 10 feet, the specific conductance increased with depth to 143 mS/cm at 14.8 feet, which was the deepest measurement.

SELECTED REFERENCES

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U.S. Geological Survey, 1975, Benton quadrangle, Louisiana, 7.5-minute series, (topographic), scale 1:62,500.

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In this report, “sea level” refers to the National Geodetic Vertical Datum of 1929--a geodetic datum derived from a general adjustment of the first-order level nets of both the United States and Canada, formerly called Sea Level Datum of 1929.

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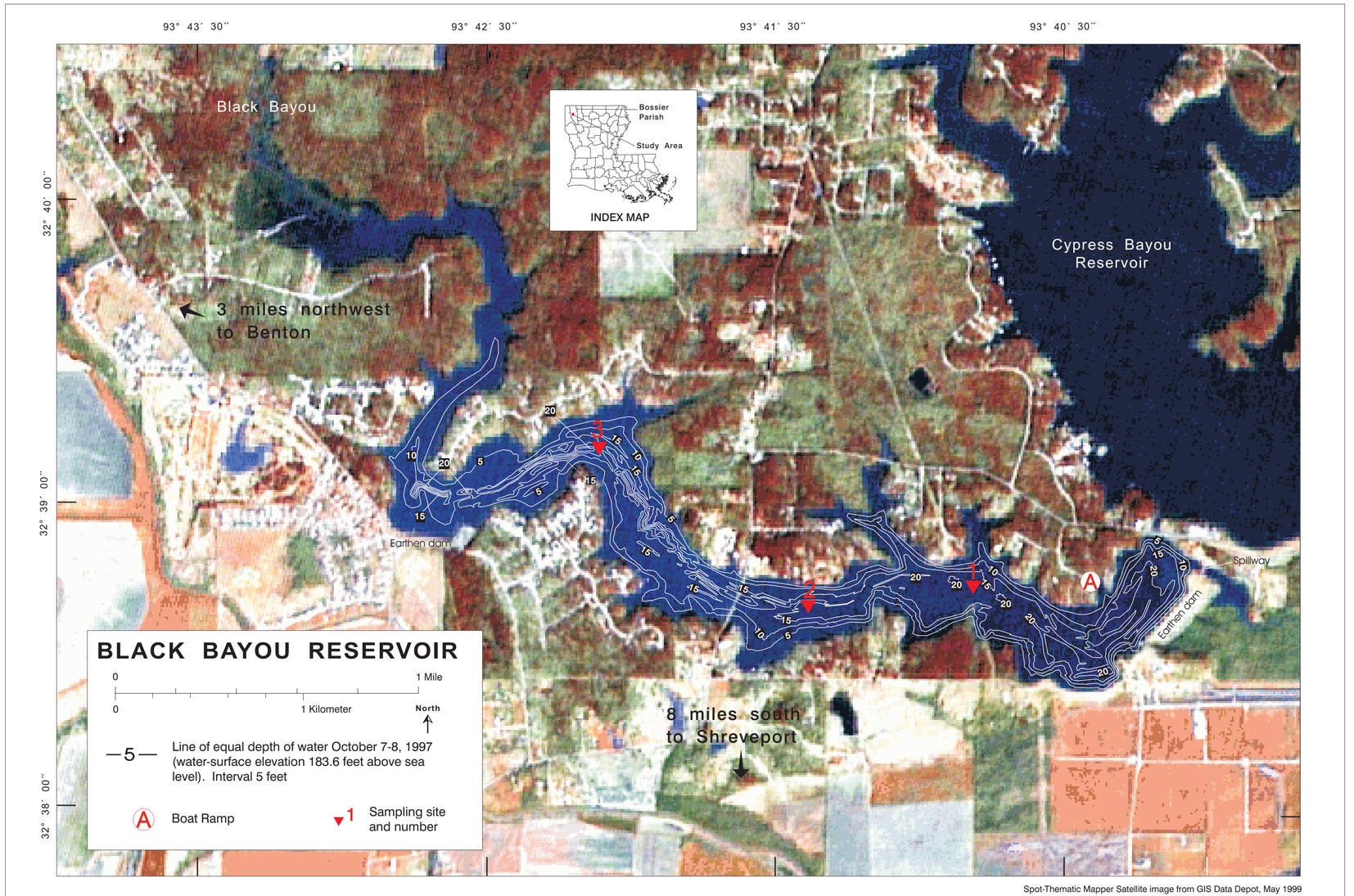

Spot-Thematic Mapper Satellite image from GIS Data Depot, May 1999

Figure 1. Bathymetry of Black Bayou Reservoir, October 7-8, 1997.

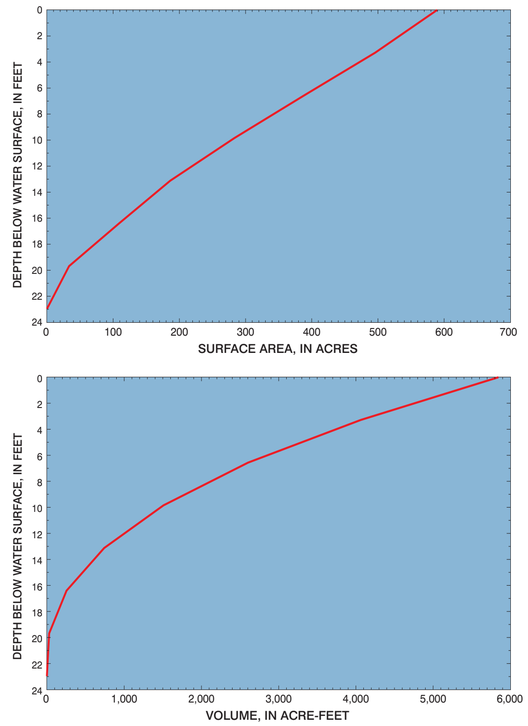

Figure 2. Depth-surface area and depth-volume relations for Black Bayou Reservoir. Water-surface elevation was 183.6 feet above sea level during the bathymetric survey of October 7-8, 1997.

Figure 3. Variation of water temperature, dissolved-oxygen concentration, specific conductance, and pH at Black Bayou Reservoir, September 24, 1997.

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Bathymetric Survey and Physical and Chemical-Related Properties of Black Bayou Reservoir, Louisiana, September and October 1997

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